Advancing the Profession:

By the NTLC Editors

The field of educational technology is under external pressure to provide evidence of identifiable learning outcomes that can be attributed to technology. Leaders within the educational technology research community agree about the importance of such evidence. Each year, ISTE and the Society for Information Technology and Teacher Education (SITE) cosponsor a National Technology Leadership Summit (NTLS) to consider such issues. One goal is to proactively facilitate needed research that will advance the profession. We would like to share our collective perspective regarding current research needs with ISTE members.

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Framing the Issues

Evidence that technology supports improved student learning can be gained only through credible research, but the way that research questions are framed plays an important role in the results obtained. In the past, media comparison studies have been commonly pursued by researchers interested in educational technology. These kinds of studies compare the effectiveness of one medium with another at improving some aspect of student learning, asking "Which is better?"

At the beginning of the 1980s, Richard Clarke conducted a well-known meta-analysis of this type of educational technology research and concluded that media do not influence learning under any conditions. He concluded that media are "mere vehicles that deliver instruction but do not influence achievement any more than the truck that delivers our groceries causes changes in our nutrition" (1983, p. 445). This perspective might be termed the transmission model of educational technology—the view that technology is a delivery mechanism with no unique capacity or capabilities that might intrinsically affect learning.

Clark's observation implies a powerful conclusion: There is probably no generic technology effect on teaching and learning. However, the transmission model of instruction is itself flawed, because it treats all instruction as generic and fails to differentiate by content being taught or by teaching strategies employed.

During the same era as Clark's meta-analysis, Lee Shulman suggested that teacher education research of that era was overlooking the central role of content and subject matter, a phenomenon he called the "missing paradigm":

> The missing paradigm refers to a blind spot with respect to content that now characterizes most research on teaching and, as a consequence, most of our state-level programs of teacher evaluation and teacher certification…. What we miss are questions about the content of the lessons taught, the questions asked, and the explanations offered. (Shulman, 1986, pp. 7–8)

Shulman believed that crucial aspects of pedagogical practice are uniquely connected to specific content areas. He went on to coin the phrase *pedagogical content knowledge* to describe this relationship.

Shulman's and Clark's observations cast new light on educational technology research. Research questions and designs that fail to differentiate by the content being studied, the pedagogical strategies employed, and the way that technology interoperates with these variables will probably continue to find that merely using a technology medium is not educationally beneficial. But research that explores how technology interacts with pedagogy and content may disprove Clark's dictum that "media do not influence learning under any conditions" (1983, p. 445).

Technological Pedagogical Content Knowledge

The field has recently begun to move toward consensus that different technologies do have unique pedagogical affordances, but that the effects of these affordances can only be understood in the context of a specific content area and a particular pedagogy (considering particular learning outcomes).

For example, science teachers can use planetarium software such as Starry Night to teach astronomy concepts in a variety of ways. Some teachers may take students to the computer lab to use the software, but they assign worksheets guiding students to merely confirm concepts stated in the textbook—still a somewhat traditional pedagogy. Other teachers may employ the same software to facilitate inquiry, engaging students in making and testing predictions and discovering astronomical patterns. Students' resulting

Facilitating Critical Research

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comprehension of the content may differ based on the teachers' pedagogy, even though both groups used the same technology.

Thus, Schulman's concept has been extended to encompass *technological pedagogical content knowledge,* or TPCK (Mishra & Koehler, 2006). The implication is that properly prepared teachers can take advantage of the unique features of technology to teach content in ways they otherwise could not.

For the present, this remains a theoretical possibility rather than a demonstrated outcome. Only a few studies involving educational technology have addressed learning outcomes such as student understanding of specific concepts in the school curriculum. Few, if any, educational technology studies showing improved student learning have addressed all three dimensions—content, pedagogy, and technological affordances.

For example, a recent study of classes using streaming video reported higher student test scores in certain content areas over classes not using streaming video (Boster, Meyer, et al., 2006). However, neither the curricular content nor the pedagogical use of the technology was described in a way that would permit replication of results. All that is reported is that digital movies were shown in the classroom. It is likely, though, that

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different teachers employed different approaches and pedagogical strategies. When specific instructional methods are not specified, it is difficult to understand the implications, or to know how such outcomes might be reliably replicated.

Until the pedagogical methods that uniquely take advantage of a technology's pedagogical affordances to achieve content-specific learning objectives are identified, it will not be possible to prepare teachers to make effective use of current and emerging technologies. Therefore, it is crucial to ensure that future research reports such variables when learning outcomes are described.

The ultimate goal is to ensure that research on technology and innovation is useful to both educators in schools and those who prepare them for these roles.

Next Steps

An ongoing goal of NTLS is continuation of dialog about needed research in the field of educational technology. An editorial titled "A Proactive Approach to a Research Agenda for Educational Technology" was published in the *Journal of Research on Technology in Education* to begin the dialogue. A May 2006 article in *L&L* specifically described key research issues identified by teacher educator associations in the content areas of mathematics, science, English, and social studies.

As a result of this year's NTLS, teacher educators in mathematics, science, social studies, English, reading, early childhood education, and special education have agreed to take the next step by summarizing in a monograph the state of the research in their fields relating to specific technologies and student learning. The intent is to facilitate research on the relationship between specific technologies and student learning of school curriculum by searching out existing models of research and advancing the discussion about the characteristics of exemplary research.

M. D. Roblyer (2005) notes that the field of educational technology currently lacks a clear theoretical foundation as a framework for research. Dialogue on this topic may move us closer to a common framework for productive research in the future. This process will also allow us to reflect on considerations that should be incorporated into the review process for the educational technology journals that collectively serve as NTLS sponsors.

The ultimate goal is to ensure that research on technology and innovation is useful to both educators in schools and those who prepare them for these roles. By presenting and analyzing instances in which effective application of TPCK has resulted in differences in learning outcomes in each of the core content areas, we hope to provide models that will stimulate more research in this vein. We invite input and recommendations from ISTE members and others regarding noteworthy research related to the effect of technology on student learning in specific content areas, and will report conclusions and outcomes as they emerge.

Resources

Boster, F. J., Meyer, G. S., Roberto, A. J., Inge, C., & Strom, R. (2006). Some effects of video streaming on educational achievement. *Communication Education, 55,* 46–62.

Clark, R. C. (1983). Reconsidering research on learning from media. *Review of Educational Research 53,* 445–59.

Mishra, P., & Koehler, M. J. (2006). Technological Pedagogical Content Knowledge: A new framework for teacher knowledge. *Teachers College Record. 108*(6), 1017–1054.

Roblyer, M. D. (2005). Educational technology research that makes a difference: Series introduction. *Contemporary Issues in Technology and Teacher Education, 5*(2), 192–201.

Shulman, L. (1986). Those who understand: Knowledge growth in teaching. *Educational Researcher, 15*(2), 4–14.

About the NTLC Editors

The NTLC Editors are a group of editors from six leading educational technology periodicals working together through the National Technology Leadership Coalition, which meets annually at the National Technology Leadership Summit. The mission of this group is to proactively facilitate research and publications that will advance the profession. Currently participating publications and editors include:

Computers in the Schools: LaMont Johnson and Cleb Maddux
Contemporary Issues in Technology and Teacher Education (*CITE* Journal): Glen Bull and Lynn Bell
Journal of Computing in Teacher Education (*JCTE*): Ann Thompson and Denise Schmidt
Journal of Research on Technology in Education (*JRTE*): Lynne Schrum
Journal of Technology and Teacher Education: Debra Sprague
Learning & Leading with Technology: Kate Conley and Anita McAnear